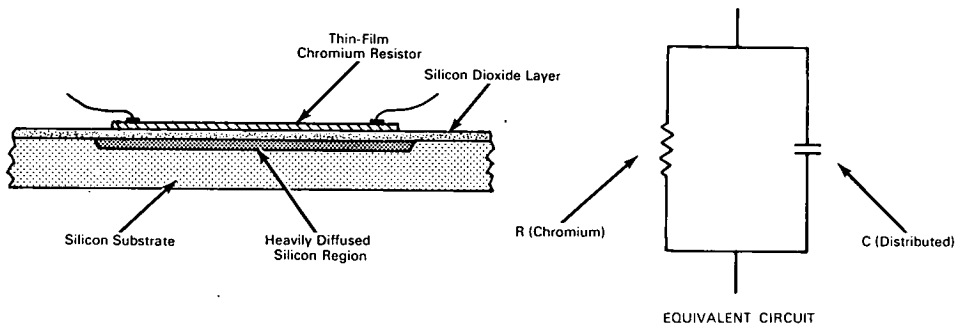
NASA TECH BRIEF

Thin-Film Resistors Used in Functional Electronic Blocks



The problem: Diffused resistors which have been used in R-C tank circuits in a solid state electronic block have a distributed parallel capacitance associated with the depletion layer of the p-n junction. Small capacitances in this R-C combination produce long rise times, while large values cause either peaking or ringing, depending on the associated inductance of the circuit. If diffused resistors are used, an optimum parallel capacitance cannot be obtained for many circuit applications requiring a resistance greater than 50K ohms and a capacitance less than 100 pf.

The solution: Use vapor-deposited thin-film resistors instead of diffused resistors in the functional electronic block.

How it's done: In the case of a silicon dioxide/silicon system, a chromium thin-film resistor is vapor-deposited over a thin silicon dioxide layer grown over a heavily diffused p or n silicon region. The distributed parallel capacitance is then controlled by the thickness of the silicon dioxide layer and the area of the chromium film. To lower the capacitance, this area is kept at a minimum consistent with the resistivities obtainable with chromium films and the thickness of the silicon dioxide layer is increased. The thicker layer also improves the reliability and reproducibility of the capacitor. If the thickness of this layer is varied from 200 to 10,000 angstroms, the capacitance will correspondingly vary from 0.9 to 0.02 pf per square mil. For a chromium film 1 mil by 100 mils with a "resistivity" of 1K ohm per square mil, the resistance will be 100K ohms and the capacitance will range from 90 to 2.0 pf as the oxide thickness is varied from 200 to 10,000 angstroms.

Notes:

1. By utilizing the distributed parallel capacitance associated with the diffused region under the silicon dioxide layer, both high- and low-value capacitors can be paralleled. Since the capacitance is internally connected, two external connections are eliminated.
2. The above principle can be applied using any thin-film metal with a sufficiently high resistivity on a variety of semiconductors to control the R-C characteristics in functional electronic blocks.

(continued overleaf)

3. Inquiries concerning this innovation may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
Greenbelt, Maryland, 20771
Reference: B65-10305

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated by NASA.

Source: Westinghouse Electric Corporation
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